(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 278 769 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88301172.8

(22) Date of filing: 12.02.88

(51) Int. Cl.[4]: D 21 F 1/00

(30) Priority: 13.02.87 US 14397

(43) Date of publication of application:
17.08.88 Bulletin 88/33

(84) Designated Contracting States:
AT BE CH DE ES FR GB IT LI NL SE

(71) Applicant: SCAPA GROUP PLC
Oakfield House 52 Preston New Road
Blackburn Lancashire BB2 6AH (GB)

(72) Inventor: Westhead, William T.
1506 City Boulevard
Waycross Georgia (US)

(74) Representative: Funge, Harry et al
M'CAW & CO. 41-51 Royal Exchange Cross Street
Manchester M2 7BD (GB)

(54) Papermakers fabric.

(57) A flat-woven papermakers fabric comprising machine direction and cross-machine direction yarns (52, 54) provided interiorly of the fabric and between layers of cross-machine direction yarns 56, 58 existing at the opposed fabric faces. The load-control yarns (52, 54) are substantially uncrimped and comprise low-stretch, high strength yarns of a kind ordinarily unsuited for use in the context of papermaking having regard to an inherently poor resistance to abrasion, heat degradation and hydrolysis.

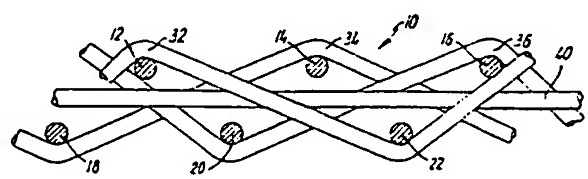


FIG 1

EP 0 278 769 A2

BEST AVAILABLE COPY

BAD ORIGINAL

Description

PAPERMAKERS FABRIC

This invention concerns woven papermakers fabrics, and relates more particularly to an improved woven papermakers fabric that exhibits substantially less machine direction stretch than other available fabric structures.

In papermaking machines, a papermakers belt in the form of an endless, belt-like fabric structure is supported on and advanced by a plurality of metallic rolls rotatably supported in the papermaking machine. The belt serves to transport paper during the various stages of its progress through the papermaking process. Papermakers belts have various names, depending upon the portion of the machine in which they are used. By way of example, papermakers belts can include so-called forming fabrics, wet press felts, and dryer felts and fabrics. In many cases, the belt or fabric is joined at its ends to form an endless belt that is supported on and controlled by various machine rolls forming part of the papermaking machine.

A papermakers fabric can be made from a one, two, three, or more plane fabric, wherein the various planes are defined by different groups of cross-machine direction yarns. The planes, plies, or layers, as they are variously called, are united by a plurality of machine direction yarns that are interwoven with cross-machine direction yarns to form a coherent fabric having desired surface, stability and permeability characteristics according to the portion of the papermaking process in which it is used. In that regard, the yarns that are used to weave the most modern papermakers fabrics are often made from synthetic monofilaments, or synthetic multifilaments, and from such materials as polyester or polyamide.

By virtue of the interwoven structure of the typical papermakers fabric, both the cross-machine direction yarns and the machine direction yarns are crimped, or bent, as they pass above or below the respective yarns with which they are interwoven. Although after weaving the fabric is subjected to heat and tension to set the yarns in the desired relative disposition, regardless of the tightness of the weave, any crimped machine direction yarn will increase in length as the fabric is placed under tension. Such a result is undesirable in that it causes the fabric to stretch and lengthen in the machine direction. As the fabric tension must be kept constant during the papermaking process, fabric stretch can cause the fabric to lengthen beyond the take-up capabilities of the paper machine in which case tension is lost and the fabric has to be removed, because it is too long. Furthermore, if the tension applied to the fabric is relatively low, the fabric may shrink back, again beyond the adjustment capabilities of the machine. In this case the tension builds up and can result in damage to the paper machine. Further complicating the situation is that the tension in the fabric as it runs is not constant and uniform along the fabric, which brings about fluctuations as the fabric travels through the papermaking machine.

One attempt to overcome stretching of a papermakers fabric on the papermaking machine involved the technique of overstretching the fabric by the fabric manufacturer during the finishing operation. However, it has been found that finishing a woven fabric by using high stretch forces will result in a built-in high shrinkage and consequent shrink forces that cause the fabric to contract on the paper machine to the point of tension build-up and subsequent machine damage. On the other hand, finishing a fabric by using low stretch forces will reduce the likelihood of it contracting on low tension positions of the machine, but it will increase the likelihood of it stretching in high tension positions on the machine. However, because in many cases neither the papermakers fabric manufacturer nor the paper mill that uses the fabric knows precisely under what tension the fabric will be operating, there is always the possibility of either fabric stretching or fabric shrinking.

It is an object of the present invention to overcome the above-described problems associated with the prior art fabric structures, and to provide a papermakers fabric that has improved resistance to stretching, so that it performs well on a large variety of papermaking machines under a variety of operating conditions.

According to the present invention there is proposed a flat woven papermakers fabric comprising a plurality of machine direction yarns and a plurality of cross-machine direction yarns interwoven in a pre-selected weave pattern, to define a woven structure having at least top and bottom layers of cross-machine direction yarns, and a plurality of load-control yarns extending in the machine direction and existing between said top and bottom layers of said cross-machine direction yarns, said load-control yarns passing linearly and substantially uncrimped through the interior of the woven fabric structure and being made from a synthetic material capable of withstanding higher tensile loads than said machine direction yarns without appreciable stretch.

The invention will now be described further, by way of example only, with reference to the accompanying diagrammatic drawings illustrating various embodiments and in which : -

Fig. 1 is a fragmentary cross-sectional view, taken along the machine direction, of one type of weave pattern constructed in accordance with the invention and having load-control yarns passing through the interior portion of the fabric in the machine direction;

Fig. 2 is a fragmentary cross-sectional view similar to that of Fig. 1, showing another form of weave structure incorporating load-control yarns in accordance with the invention;

Fig. 3 is a fragmentary cross-sectional view similar to that of Fig. 1 showing a still further form of weave structure incorporating load-control yarns in accordance with the invention;

Figs. 3A and 3B provide weaving details for the fabric of Fig. 3; whilst Fig. 3C is a diagrammatic plan view of a p[illegible] such fabric;

Figs. 4 to 14 show alternative weave structures that incorporate load-control yarns in accordance with the invention.

Referring now to the drawings, and particularly to Fig. 1, there is shown a portion of a papermakers fabric 10 that includes a plurality of cross-machine direction yarns 12 to 22 interwoven with a plurality of machine direction yarns 32 to 36 to provide a semi-duplex fabric. As is clearly apparent from Fig. 1, the base, or interwoven portion, of the fabric is characterised by having three ends and a six pick repeat.

Fabric 10 includes a plurality of machine direction yarns 40 (only one of which is visible in Fig. 1) that pass directly through the centre of the fabric structure, and are arranged in parallel relationship to define an intermediate plane within the fabric, the intermediate plane lying between the plane defined by upper cross-machine direction yarns 12, 14 and 16, and the plane defined by lower cross-machine direction yarns 18, 20 and 22. By passing straight through the fabric structure, and without being crimped, the centre machine direction or load-control, yarns 40 are able to undergo a higher tensile load without substantial stretch, as compared with machine direction yarns interwoven with cross-machine direction yarns.

The types of yarns that can be used to provide the interwoven fabric structure, exclusive of the load-control yarns, can be any of a variety of synthetic materials such as polyesters, polyamides, and the like. For example, nylon has excellent resistance to abrasion, although it will extend or contract in use. Thus the preferred machine direction yarns, which can be selected to provide a standard temperature and hydrolysis resistant warp structure, preferably include a combination of polyester, nylon and acrylic yarns so engineered as to combine the best properties of each yarn. For example, the polyester and nylon yarns resist wear, the nylon and acrylic yarns resist hydrolysis, the polyester and acrylic yarns resist heat, and the polyester yarns give fabric stability. Similarly, a high temperature and hydrolysis resistant warp structure can include a combination of polyester, nylon, acrylic, Nomex, and Kevlar yarns. In that case the polyester and nylon yarns resist wear, the acrylic, nylon and Nomex yarns resist hydrolysis, the polyester, acrylic and Nomex yarns resist heat, and the polyester and Kevlar yarns give fabric stability.

In the case of the cross-machine direction yarns, standard cross-machine yarns usually combine glass, polyester, and nylon and are engineered to give excellent cross-machine stability and medium to high permeability. A design having a machine direction float face can be used to produce a smooth face fabric as shown in Fig. 14. This can be produced with standard cross-machine yarns or, for ultra smoothness, can be produced with glass and acrylic or similar cross-machine yarns.

In the case of the load-control yarns, the preferred material is Kevlar, which has high strength, but offers poor resistance to plucking-type wear. However, by using Kevlar as the straight-through load-control yarns interiorly of the fabric, advantage can be taken of its low stretch and high strength characteristics to control overall fabric stretch. By their location in the interior of the fabric, the Kevlar yarns are fully protected from wear, and hence their relatively poor abrasion characteristics do not result in loss of fabric strength during fabric life on the paper machine. Similarly, when nylon is employed in the basic weave, because the nylon has excellent abrasion resistance, it will exhibit less wear, but the poor resistance of nylon to stretch and contraction is overcome because those properties of the fabric are controlled by the Kevlar yarns in the interior of the fabric. That Kevlar yarns are suitable for use in the context of papermakers fabrics and particularly as load-control yarns therein is totally unexpected given that Kevlar yarns are particularly susceptible to physical damage on being bent and that the machine direction yarns of a fabric are repeatedly bent or flexed on passage through the papermaking machine. Surprisingly, however, the Kevlar yarns, when employed as described above, provided excellent results. In particular, the Kevlar straight-through machine direction yarns did not exhibit the weakness inherent in such yarns, perhaps because such yarns were not crimped in the manner normal with machine direction yarns but perhaps also because they were protected by other yarns. More particularly, the performance of Kevlar was markedly better than was anticipated.

Referring now to Fig. 2, an alternative fabric structure is illustrated in which double machine direction yarns 42, 44 and 46, 48, for example, pass over respective ones of each of the outwardly facing surfaces of each of the cross-machine direction yarns to further increase the resistance of the fabric to surface wear. This particular fabric structure is especially suitable where the fabric is subjected to a high degree of abrasion, as could exist, for example, when rusty or rough surface rolls are present in the papermaking machine. Additionally, as clearly apparent from the Fig. 2 embodiment, two load-control yarns 52, 54 are provided in the same plane in each repeat of the fabric design.

Fig. 3 illustrates a flat-woven fabric comprising three layers of weft, or cross-machine direction, yarns 56 woven with warp, or machine direction, yarns 58, there being straight load-control yarns 52, 54 between the respective layers of weft yarns.

In a typical arrangement, the weft yarns 56 will comprise a latex-coated multifilament glass yarn double-wrapped with 550 d'tex polyester yarn, whilst the warp yarns 58 each comprise a three-fold yarn made up of 0.2 mm monofilament polyester (e.g. Trevira Monofilament 900C), 235 d'tex nylon (e.g. Monsanto Nylon A02) and 220 d'tex acrylic (e.g. Dralon T), the warp yarns being heat set.

The load-control yarns 52, 54 are also of three-fold construction and consist of two doubled 280 d'tex polyester (e.g. Terylene Type 129) twisted together and with a single 440 d'tex Kevlar yarn (e.g. Kevlar 29).

The pattern repeat is on six ends and six picks

expanded for use on 12 shafts, whilst the drafting is such as to repeat on thirty-two ends, the weave and draft diagrams being as shown in Figs. 3A and 3B, like identification being used in the two parts of Fig. 3A for specific yarns.

The warp density in the loom is typically 142 ends per 10 cms, the corresponding load-control yarn density being 47 ends per 10 cms. The reed has 472 dents per metre, and the warp and load-control yarns are drawn in at eight ends per dent using only alternate dents, there being six warp yarns and two load-control yarns in each dent so utilised.

The weft yarns are introduced on the basis of 132 picks per 10 cms.

The fabric of Fig. 3 will accordingly present spaced bands of yarn extending in the machine direction, with the two load-control yarns in each such band arranged within and protected by the other machine direction yarns which pass through the same dent in the reed, the band effect being illustrated diagrammatically in Fig. 3C and the positions of the load-control yarns relative to the other machine direction yarns in the same dent being apparent from Fig. 3b.

In order to ensure maximum resistance to fabric stretch by virtue of the presence of the load-control yarns 52, 54 such yarns are captivated by back-sewing at the fabric ends.

It has been found that the improved dimensional stability of the fabric in the machine direction thereof, and arising from the presence of the load control yarns, has a beneficial effect as regards permeability, in that the interstices between the yarns will remain substantially constant in size and will thus approximate more closely to the design geometry of the fabric. It is thought that the manner in which the cord yarns are held in the denting and drafting pattern, and are precluded from wavering or spreading contributes to the improvement.

By way of comparison, whilst the break load of the warp yarns 58 per se and the load-control yarns 52, 54 is essentially the same, the extension at break of such yarns is materially different, being approximately 25% in the former case and approximately 4% in the latter case.

Further base fabric weaves that can be adopted, and in which the load-control yarn concept of the present invention can be employed, are illustrated in Figs. 4 to 14. In Fig. 4, 5 and 7, 12 and 13, three-ply fabrics are illustrated, each having a pair of planes of load-control yarns 52,54. The two planes are each defined by a plurality of machine direction load-control yarns, the planes being symmetrical with a centre plane of the fabric structure and being equally spaced on each side of the centre plane. In Figs. 6 and 8 to 11 and 14, two-ply fabrics are illustrated, each having two load-control yarns 52, 54 in the same plane in each repeat of the fabric design. In each fabric structure illustrated, load-control yarns 52, 54 define either one or more parallel planes that pass through the fabric structure without being interwoven with the cross-machine direction yarns. The load-control yarns are preferably either at the fabric centre plane, or, if plural planes are defined by the load-control yarns as in the structure shown in each of Figs. 4, 5, 7, 12 and 13, at planes symmetrically positioned with respect to the fabric centre plane. However, as illustrated in Fig. 6, it is also possible to arrange the load-control yarns 52, 54 so that they are disposed in a single plane on one side of the fabric centre plane, with the load-control yarns in the same plane in each repeat of the fabric design.

The ends of fabrics embodying the present invention will be joined together, to form an endless belt, by means of conventional seams of a kind well known to those skilled in the art.

In addition to providing a fabric having reduced stretch as compared with the prior known fabrics, the above-described fabric structures having load-control yarns passing therethrough can be designed to provide fabric permeability in the range of from 0 to 600 cfm, depending upon the types of yarns and the type of weave employed.

Although, as pointed out above, a range of weave patterns can be employed to take advantage of the low stretch characteristics of load-control-yarns as hereinabove described, the preferred fabric structures for use on papermaking machines are the structures illustrated in Figs. 1, 2 and 3 of the drawings.

Whilst it had been thought that Kevlar yarns, that is to say yarns comprising paralinked aramid filaments, had a high resistance to heat and moisture, there is clear evidence that such yarns are adversely affected by extended exposure to heat and moisture, thus leading to the widely held view that Kevlar yarns have limited application in the context of papermakers fabrics, and particularly dryer fabrics for papermaking machines. However, we have found that the strength of Kevlar yarns included in a papermakers fabric in the manner hereinproposed is not materially impaired, notwithstanding the adverse environment in which the fabric operates and the extended operating life required of that fabric.

It is not clear why the strength characteristics are retained, although it may be that the manner in which the Kevlar yarns are surrounded by the remaining yarns present in the fabric operates to insulate the load-control yarns from the adverse effects of extended exposure to heat and moisture, this being particularly so of the Fig. 3 embodiment hereof wherein the Kevlar yarns exist within a band of machine direction yarns and form a core, as it were, to such band.

The invention is not restricted to the exact details of the embodiments hereinbefore described, since alternatives will readily present themselves to one skilled in the art. Thus, for example, paralinked aramid yarns other than Kevlar may be used (such as, for example, TWARON) as too may yarns comprising aromatic ether amides (for example, TECNORA).

Claims

1. A flat-woven papermakers fabric compris-

BAD ORIGINAL

ing a plurality of machine direction yarns and a plurality of cross-machine direction yarns interwoven in a pre-selected weave pattern to define a woven structure having at least top and bottom layers of cross-machine direction yarns and a plurality of load-control yarns extending in the machine direction and existing between said top and bottom layers of said cross-machine direction yarns, said load-control yarns passing linearly and substantially uncrimped through the interior of the woven fabric structure and being made from a synthetic material capable of withstanding higher tensile loads than said machine direction yarns without appreciable stretch.

2. A papermakers fabric as claimed in claim 1, wherein the plurality of load-control yarns lies substantially in a single plane between the top and bottom layers of cross-machine direction yarns.

3. A papermakers fabric as claimed in claim 1, wherein the load-control yarns define a single plane substantially midway between the top and bottom layers of cross-machine direction yarns.

4. A papermakers fabric as claimed in claim 1, wherein the load-control yarns define spaced planes within the interior of the fabric.

5. A papermakers fabric as claimed in claim 4, wherein the load-control yarns define two planes spaced from and on opposite sides of a plane passing through the centre of the fabric.

6. A papermakers fabric as claimed in claim 5, wherein the load-control yarns define two planes arranged in closely spaced relationship and assymetrically positioned with respect to a plane passing through the centre of the fabric.

7. A papermakers fabric as claimed in any one of claims 4 to 6, including at least one further layer of cross machine direction yarns intermediate the aid top and bottom layers thereof.

8. A papermakers fabric as claimed in claim 7, wherein one further layer of cross-machine direction yarns exists in the fabric, said further layer being positioned between two adjacent planes of load-control yarns.

9. A papermakers fabric as claimed in any one of the preceding claims, wherein the load-control yarns are secured relative to the fabric at the respective opposite ends thereof.

10. A papermakers fabric as claimed in any one of the preceding claims, wherein the machine direction yarns exist as spaced bands, the load-control yarns being positioned wholly within respective ones of the said bands to be protected by the yarns of said band.

11. A papermakers fabric as claimed in claim 10, wherein each band includes at least one load-control yarn.

12. A papermakers fabric as claimed in any one of the preceding claims, wherein the load-control yarns comprise Kevlar.

13. A papermakers fabric as claimed in claim 11, wherein each band includes two load-control yarns and six machine direction yarns, the load-control yarns being separated from each other and from the lateral edges of the band by two machine direction yarns.

BAD ORIGINAL

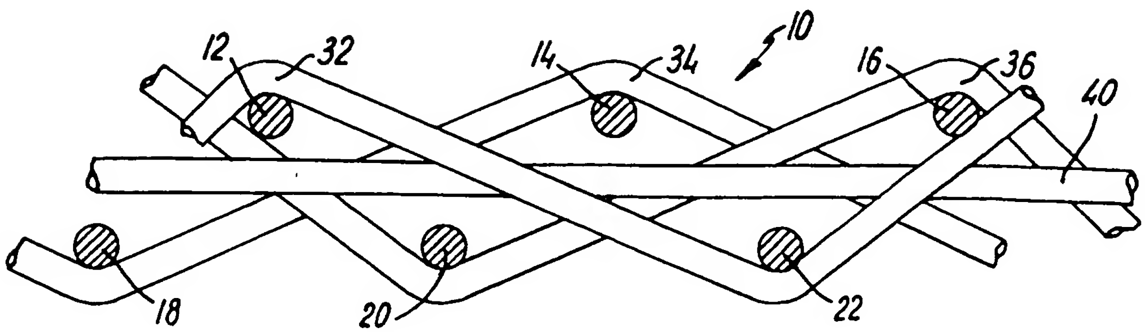


FIG. 1

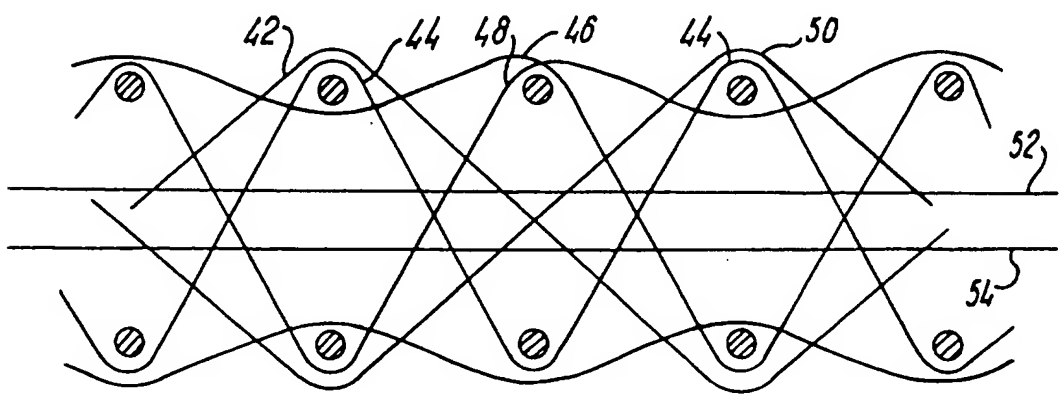


FIG. 2

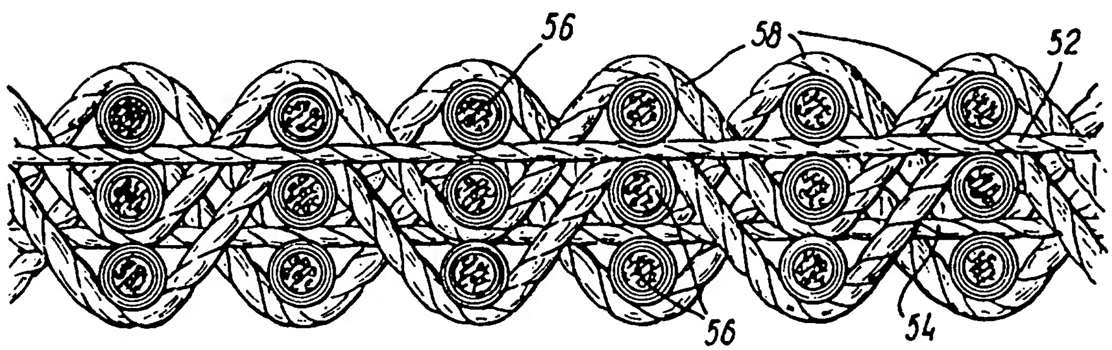


FIG. 3

0278769

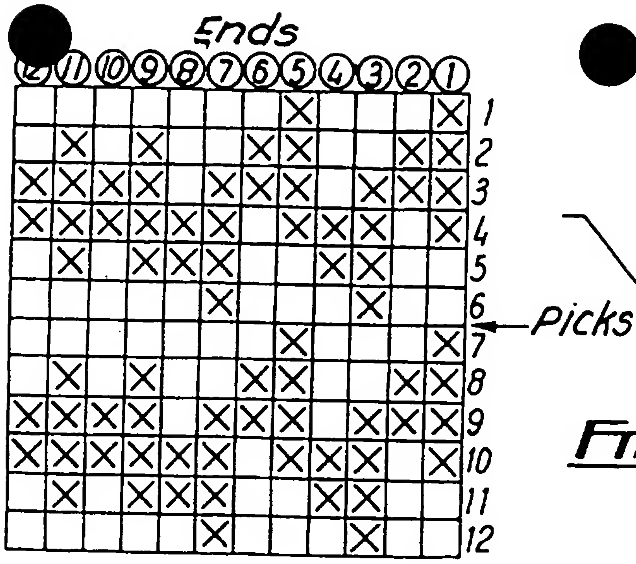
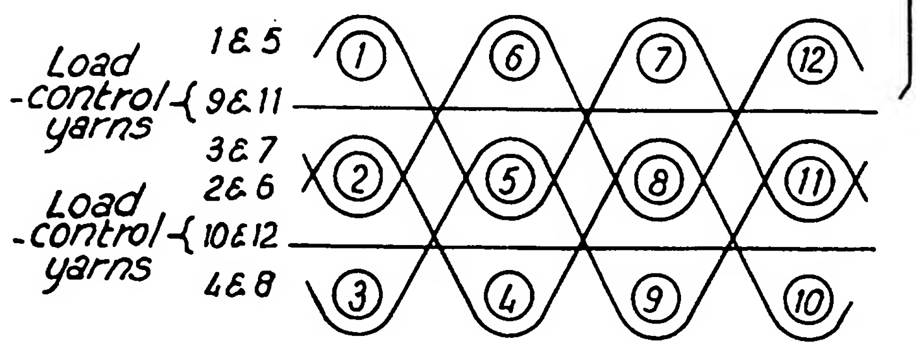


FIG. 3A



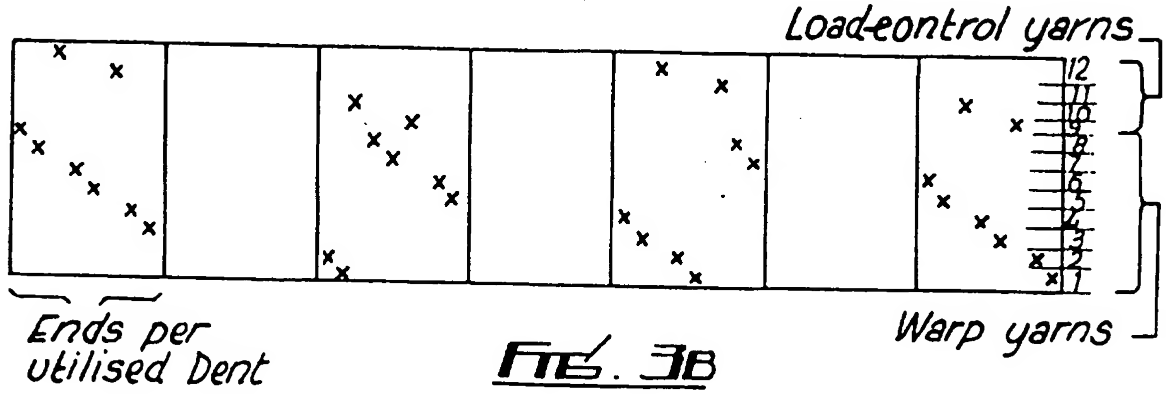
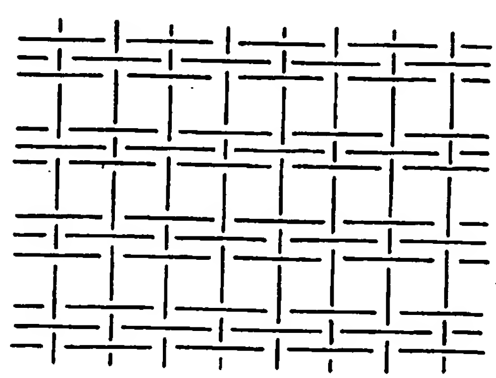


FIG. 3B

FIG. 3C



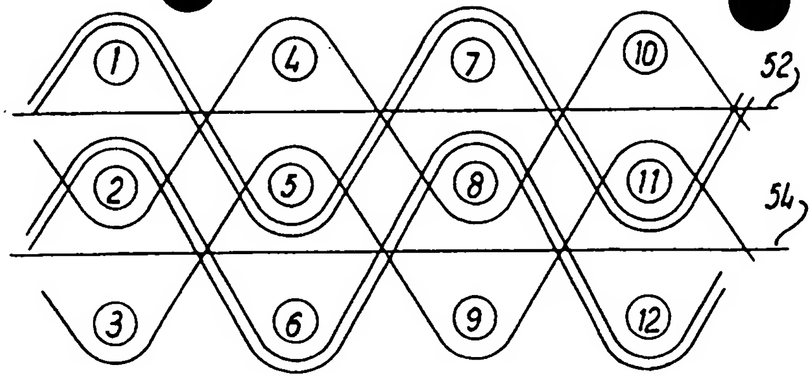


FIG. 4

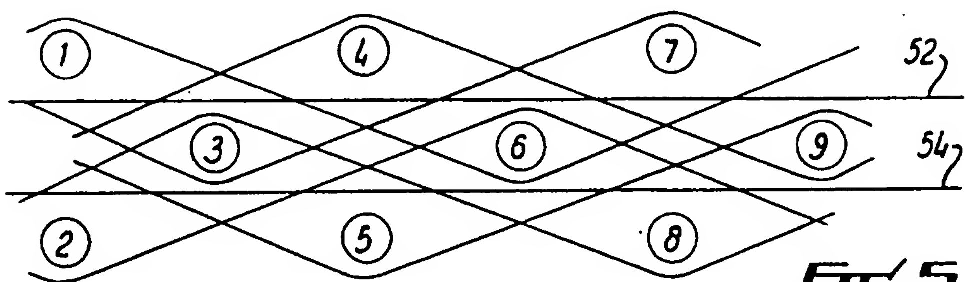


FIG. 5

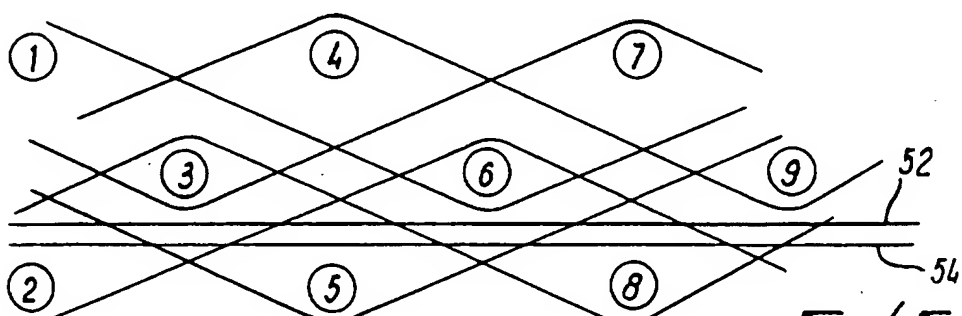


FIG. 6

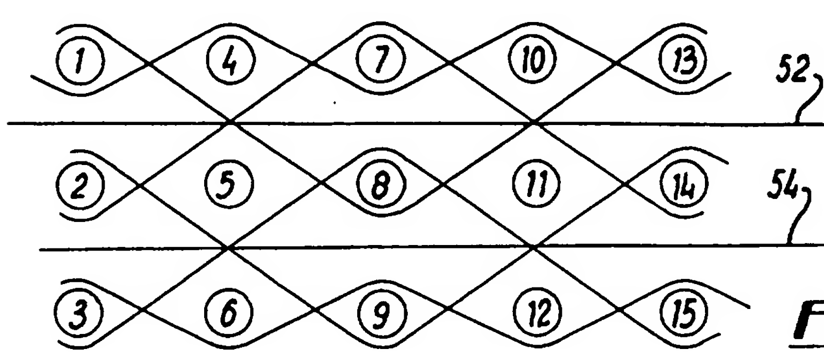


FIG. 7

0278769

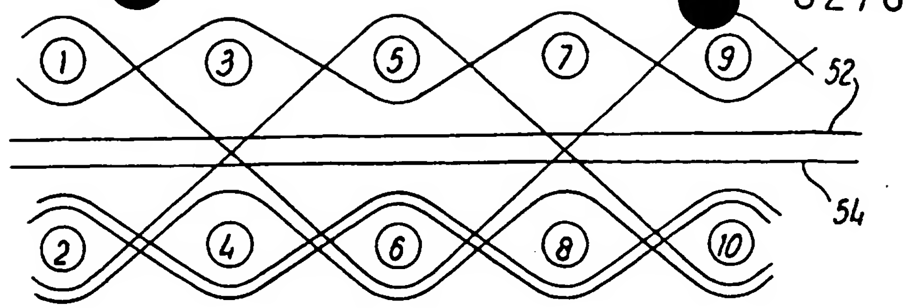


FIG.8

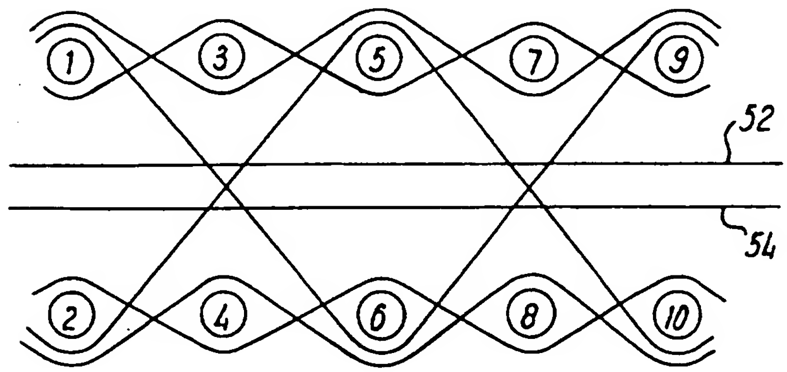


FIG.9

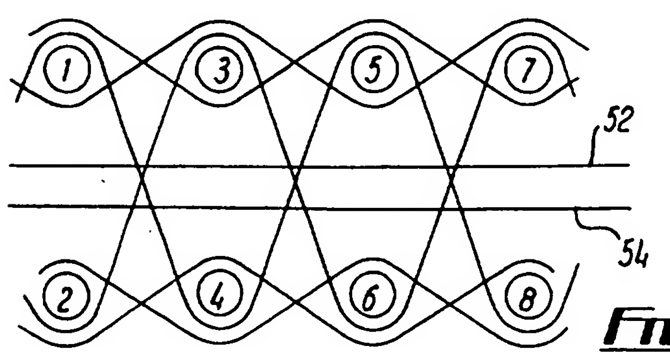


FIG.10

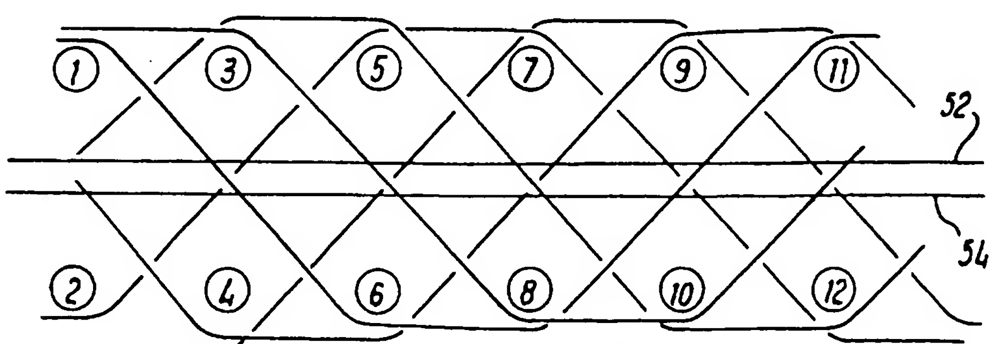


FIG.11

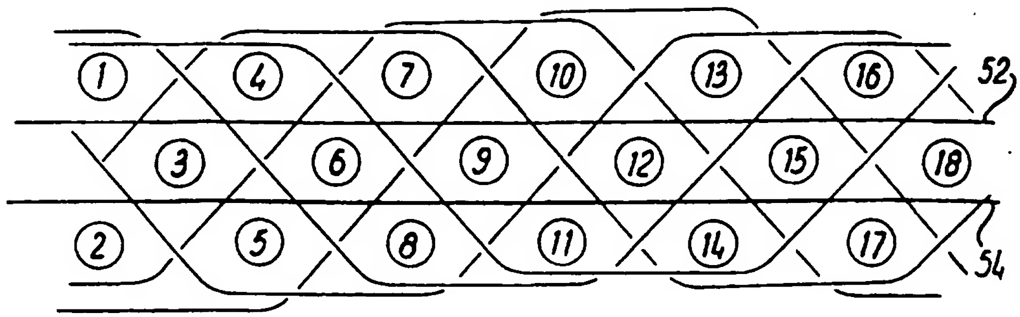


FIG. 12

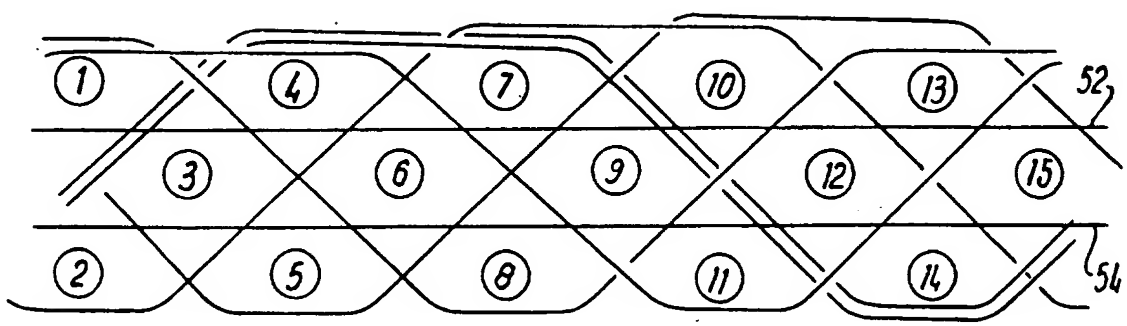


FIG. 13

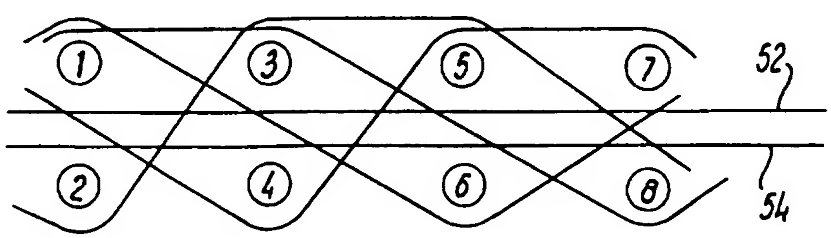


FIG. 14